

CLAIMS

1. A turbocharger for an internal combustion engine, comprising
a rotating assembly comprising a turbine wheel and a compressor wheel carried at the
opposite ends of a shaft,
5 a stationary housing comprising an exhaust gas volute for directing engine exhaust
gas through said turbine wheel to rotate the rotating assembly, a compressor casing for
collection of compressed air from the compressor wheel and a bearing housing, and
a bearing system for rotatably carrying said rotating assembly within the stationary
housing, said bearing system comprising an elongated bearing carrier removably supported
10 by a plurality of elastic elements between the elongated bearing carrier and said bearing
housing, and a pair of anti-friction ball bearings, one anti-friction ball bearing being axially
spaced and carried by the elongated bearing carrier adjacent each of its ends, said pair of anti-
friction ball bearings being engaged with said shaft and rotatably carrying said rotating
assembly within said stationary housing.
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2. The turbocharger of claim 1 wherein the bearing housing and elongated bearing
carrier form a coolant cavity sealed between the bearing housing and elongated bearing
carrier by the plurality of elastic elements, and wherein coolant can be circulated through said
coolant cavity in contact with said elongated bearing carrier to remove heat from the rotating
20 assembly and anti-friction ball bearings.
3. The turbocharger as in claim 1, wherein the bearing housing contains an annular
coolant water passage that communicates with the outside surface of the elongated bearing
carrier and has an inlet and outlet for admitting and expelling engine coolant.
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4. The turbocharger as in claim 1, wherein the anti-friction ball bearings are angular
contact ball bearings that accept thrust in one direction only.
5. The turbocharger as in claim 4, wherein the angular contact ball bearings comprises
30 full complement ball bearings.
6. The turbocharger as in claim 1, wherein the anti-friction ball bearings comprise
ceramic balls.

7. The turbocharger as in claim 1, wherein the anti-friction ball bearings comprise angular contact ball bearings carrying a full complement of ceramic balls.
8. The turbocharger as in claim 1, wherein the anti-friction ball bearing on one end of the elongated cylinder is mounted in a tolerance ring that surrounds the outside diameter of the anti-friction ball bearing.
9. The turbocharger as in claim 1, wherein the elongated bearing carrier includes outwardly projecting flange surfaces, the stationary housing has surfaces adjacent the outwardly projecting flange surfaces of the elongated bearing carrier, and an anti-friction material is located between the outwardly projecting flange surfaces and the stationary housing surfaces, said outwardly projecting flange surfaces and the adjacent housing surface cooperating to bear thrust loads of the rotating assembly.
10. The turbocharger of claim 1, further comprising an electric motor-generator having a motor housing connected to and carried by the compressor casing and a motor-generator rotor connected to the turbocharger shaft.
11. The turbocharger of claim 10, wherein the motor housing forms an inlet to the compressor wheel of the turbocharger with surfaces in heat transfer relationship with the motor components and electronic control.
12. The turbocharger of claim 2 wherein said elongated bearing carrier has a cylindrical outer surface, and said plurality of elastic supports are a pair of O-rings, one O-ring surrounding the cylindrical outer surface of the elongated bearing carrier adjacent each of its ends.
13. In a bearing system for a rotating assembly carried by a housing of a turbocharger for an internal combustion engine, the improvement wherein the bearing system and housing combine to form a coolant cavity by a removable elongated bearing carrier whose outer surface forms one surface defining the coolant cavity and is sealed with said housing by an elastomeric band on each side of said one surface, said elastomeric bands also carrying and cushioning the bearing system and rotating assembly from shock and vibration loads.

14. The improvement of claim 13 wherein said removable elongated bearing carrier has a cylindrical outside surface with a peripheral O-ring groove formed on each side of said one surface, and said elastomeric bands are O-rings seated in said peripheral grooves.

5 15. In a bearing system for a rotating assembly carried by a housing of a turbocharger for an internal combustion engine, the improvement comprising an elongated cylindrical bearing carrier removably supported within the housing by a pair of elastomeric bands surrounding the elongated cylindrical bearing carrier, with one elastomeric band being located adjacent each end of the elongated cylindrical bearing carrier between the elongated cylindrical
10 bearing carrier and the housing, a pair of angular contact anti-friction bearings with a full complement of ceramic balls carried within the elongated cylindrical bearing carrier by their outer races, their inner races rotatably carrying the rotating assembly, with one of the pair of angular contact anti-friction bearings being carried adjacent each end of the elongated cylindrical bearing carrier and carrying thrust in one direction, the direction of the thrust
15 being carried by each angular contact ball bearing being the opposite of the direction of the thrust being carried by the other angular contact ball bearing.

16. The improvement of claim 15, wherein the housing forms a coolant cavity in contact with the elongated cylindrical bearing carrier, said coolant cavity being sealed by said pair of
20 elastomeric bands, whereby heat is transferred from said rotating assembly and angular contact anti-friction bearing to coolant supplied to said coolant cavity.

17. The improvement of claim 16 wherein the elongated cylindrical bearing carrier has a cylindrical outside surface with a pair of peripheral grooves, one peripheral groove being
25 formed adjacent each of the ends of the elongated cylindrical bearing carrier, and the pair of elastomeric bands comprise O-rings seated in the pair of peripheral grooves, engaging the housing and sealing the coolant cavity.

18. A bearing system for a shaft rotating at high speeds about an axis of rotation
30 comprising:

an elongated cylinder having a cylindrical outside surface, a central bore and an outwardly projecting annular flange for forming a pair of thrust-bearing surfaces, a first anti-friction ball bearing in the central bore at one end of the elongated cylinder; a second anti-friction ball bearing in the central bore at the opposite end of the elongated cylinder; two
35 peripheral grooves spaced axially apart around the cylindrical outside surface; two elastic

members with each elastic member being carried in one of the peripheral grooves; and a spacer between the inner races of said anti-friction ball bearings, the inner races of said anti-friction ball bearings carrying said shaft.

- 5 19. A bearing system as in claim 18, wherein the outwardly projecting annular flange surfaces are provided with an anti-friction material.
20. A bearing system as in claim 18, wherein the anti-friction ball bearings are angular contact ball bearings that accept thrust in one direction only.
- 10 21. A bearing system as in claim 20, wherein the angular contact ball bearings comprises full complement ball bearings.
- 15 22. A bearing system as in claim 18, wherein the anti-friction ball bearings comprise ceramic balls.
23. A bearing system as in claim 18, wherein the anti-friction ball bearings comprise angular contact ball bearings carrying a full complement of ceramic balls.
- 20 24. A bearing system as in claim 18, wherein the anti-friction ball bearing on one end of the elongated cylinder is mounted in a tolerance ring that surrounds the outside diameter of the anti-friction ball bearing.